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Effects of Safety Behaviors on Distress Tolerance: An Experimental Investigation

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Effects of Safety Behaviors on Distress Tolerance: An Experimental Investigation

by

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Abstract

Effects of Safety Behaviors on Distress Tolerance: An Experimental Investigation

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This is the first study to investigate the effects of distress tolerance on safety behaviors through experimental manipulation of safety behaviors and the rationale of their use. This study hypothesized that: (1) relative to no safety behavior controls, subjects who are randomized to use safety behaviors will display poorer distress tolerance as measured by shorter immersion time (seconds) on a subsequent cold pressor challenge, (2) participants who are led to believe that the safety aid (liquid) will prevent circulation problems (threat-relevant rationale) will show increased distress tolerance (longer immersion time) in the first round but decreased distress tolerance (shorter immersion time) in the second round of the cold pressor compared to participants who used the safety aid without a threat-relevant rationale, because appraisals of threat increase when the safety behavior is removed, (3) individuals with low baseline distress tolerance will be more sensitive to the threat-relevant rationale safety behavior manipulation than those with high baseline distress tolerance. Therefore, individuals with low distress tolerance at baseline and who are assigned to use safety behaviors with a threat-relevant rationale will

have a larger decline in distress tolerance (i.e. difference in immersion time) between the two challenges of the cold pressor, and (4) differences in threat appraisal between Challenge 1 (safety behaviors with threat-relevant rationale available) and Challenge 2 (no safety behaviors available) will mediate the effects on differences in distress tolerance (i.e. shorter immersion time) and emotional reactivity (i.e. negative affect) between the challenges. Inconsistent with our hypotheses, participants' threat appraisals did not mediate the negative effects of safety behaviors on distress tolerance; the difference of immersion time was not significantly shorter during the second round of the cold pressor. Moreover, this mediation was not moderated by individuals' levels of physical and emotional distress tolerance at baseline. Confirming previous findings, this study's results suggest that people with low physical dispositional distress tolerance are doing worse overall when under distressing circumstances. The results also suggest that the influence of safety behaviors on dispositional distress tolerance may not impede the effectiveness of anxiety disorder treatment.

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Introduction

Anxiety disorders represent the most prevalent class of mental disorders in the United States (Kessler, Chiu, Demler, & Walters, 2005). Consequently, illumination of the factors that increase the risk for anxiety disorders has important public health benefits. Distress tolerance (Keough et al., 2010; Anestis, Selby, Fink, & Joiner, 2007; Brown, Lejuez, Kahler, Strong, & Zvolensky, 2005; & Linehan, 1993) and safety behaviors (Olatunji, Etzel, Tomarken, Ciesielski, & Deacon, 2011; & van Uijen &Toffolo, 2015) have been shown to serve as transdiagnostic risk factors for psychopathology. Since it is known that low distress tolerance is likely to increase an individual's use of dysregulated behaviors, it can be theorized that these dysregulated behaviors could encompass safety behaviors. However, there is limited research documenting 1) the relationship between safety behaviors and distress tolerance specifically and 2) the role distress tolerance plays in the development and/or maintenance of certain psychopathology symptomatology, possibly aided by safety behaviors.

DISTRESS TOLERANCE

Distress tolerance is an individual's ability to tolerate negative emotional or physical distress. It has been shown to affect the appraisal and consequences of experiencing negative emotional or physical states (Keough et al., 2010) and lower distress tolerance has been shown to confer increased risk for tobacco use and dependence (Brown, Lejuez, Kahler, Strong, & Zvolensky, 2005; Heckman et al., 2018;

Mathew et al., 2019), and sleep problems (Reitzel et al., 2017). Moreover, Linehan's (1993) theoretical work highlights an individual's inability to tolerate emotional distress as one of the central mechanisms of borderline personality disorder.

An individual's inability to tolerate emotional or physical distress is also associated with an increased vulnerability to certain anxiety symptoms (Keough et al., 2010). Specifically, anxiety psychopathology related to panic, social anxiety, generalized anxiety, obsessive-compulsive anxiety (Daughters et al., 2009), and agoraphobia (Telch, Jacquin, Smits, & Powers, 2003). Moreover, as distress tolerance decreases, an individual's anxiety-related symptomatology increases (Anestis, Selby, Fink, & Joiner, 2007; Keough et al., 2010; Katz, Rector, & Laposa, 2017). For example, individuals with higher intolerance of uncomfortable physical stimuli had significantly higher fear responding to a biological challenge provoking emotional anxiety reactivity relative to individuals with lower intolerance (Schmidt & Trakowski, 1999; Bonn-Miller, Zvolensky, & Bernstein, 2009).

Distress intolerance has also been linked with avoidance behavior (Telch, Jacquin, Smits, & Powers, 2003) which may help explain its psychopathogenic effects. Individuals who are less tolerant of aversive physical and emotional stimuli may be more motivated to avoid certain situations that trigger this discomfort, leading to maladaptive anxiety-relevant learning (Leyro, Zvolensky, & Bernstein, 2010). Specifically, individuals with lower levels of distress tolerance are more likely to be hyper-reactive to physically distressing and emotional experiences, and engage in dysregulated behavior in an attempt to cope with their negative emotions or physical discomfort (Keough et al., 2010).

Therefore, certain safety behaviors (i.e. avoidance) are likely to reduce distress tolerance temporarily for the individual, but do not necessarily reduce distress tolerance in the long term.

SAFETY BEHAVIORS AND THEIR ROLE IN PATHOLOGICAL ANXIETY

Engaging in unnecessary actions to prevent, escape from, or reduce the severity of a perceived threat is a ubiquitous feature of all anxiety disorders (Telch & Lancaster, 2012). Moreover, an individual's specific safety behaviors have been shown to be linked to their specific threat perceptions (Salkovskis, 1991).

Safety behaviors have been associated with both the development and maintenance of pathological fear. Olatunji, Etzel, Tomarken, Ciesielski, and Deacon (2011) randomized individuals to either 1) monitor or 2) monitor and perform certain safety behaviors related to health. Individuals that monitored their behaviors and performed certain health-related safety behaviors had an increase in anxiety symptomatology compared to those that were randomized to the monitor behavior alone (Olatunji, et al., 2011). Similarly, van Uijen and Toffolo (2015) compared three groups; a group instructed to increase checking behavior for obsessions, a group instructed to just check behaviors and cognitions surrounding obsessions, and a no-instruction control group. The only group that had an increase in threat appraisals toward obsession-related cognitions was the group instructed to increase their use of safety behaviors (van Uijen &Toffolo, 2015). This further supports the finding from Olatunji et al. (2011) that the action of performing safety behaviors alone may mediate the exacerbation of certain psychopathology symptomatology surrounding subsequent threat appraisals.

PREVENTATIVE SAFETY BEHAVIORS VERSUS RESTORATIVE SAFETY BEHAVIORS

Preventative safety behaviors are unnecessary actions used to minimize the threat in the immediate context (Goetz, Davine, Siwiec, & Lee, 2016). For example, an individual with OCD might use a glove or paper towel to open a public door. In contrast, restorative safety behaviors are the unnecessary actions used following a confrontation of a perceived threat (Goetz et al., 2016). In this same example, the individual might continuously wash their hands after opening a public door.

Preventative safety behaviors have also been found to impact extinction and conditioned fear. Lovibond, Mitchell, Minard, Brady, and Menzies (2009) conducted an experiment where participants learned that colored squares were followed by a shock, and other squares were not. After learning this Pavlovian shock pattern, half of the participants were taught to press a button that would prevent the shock from occurring (preventative safety behavior), and the other half was not. In the third round, all participants were shown the different colored squares without the shock-prevention button available. Subjects who did not have the preventative safety behavior available showed normal extinction/fading to the third stimulus, whereas participants who had access to the preventative safety behavior showed significantly less extinction to the third stimulus (Lovibond et al., 2009). Similarly, Engelhard, van Uijen, van Seters, and Velu (2015) found that participants who utilized a safety behavior in response to a certain stimulus falsely linked to a shock increased the threat appraisal of their expectancy of the shock to that stimulus, compared to participants who did not have access to safety behaviors. Therefore, safety behaviors not only increase threat appraisal but also may continue to exist even after the fear has been extinguished.

SAFETY BEHAVIORS AND THEIR ROLE IN ANXIETY TREATMENT

Having safety behaviors available during treatment reduces the effectiveness of exposure-based therapies. One theory suggests that people who engage in safety behaviors attribute their safety to the availability or use of safety behaviors and thus perpetually maintain their faulty threat perception in response to the feared target (Salkovskis, 1991). For example, panic patients who credit their improvements in therapy to their medication as opposed to their personal efforts had poorer outcomes than those that attributed their gains to only their personal efforts (Ba, Marks, Kili, Brewin, & Swinson, 1994; Biondi & Picardi, 2003). A second theory as to why safety behaviors hamper exposure therapy outcomes suggests that during treatment, safety behaviors interfere with threat disconfirmation processing (Sloan & Telch, 2002; Telch & Lancaster, 2012). Therefore, fading safety behaviors during exposure therapy actually enhances treatment outcomes.

SUMMARY AND HYPOTHESES

It is important to better understand the different mechanisms and risk factors that contribute to the onset and maintenance of anxiety. The current study tested the effects of distress tolerance on safety behaviors through experimental manipulation of safety behaviors and the rationale of their use. More specifically, through this experimental manipulation, we examined whether threat appraisals mediate the negative effects of safety behaviors on distress tolerance. Since both distress tolerance and the use of safety behaviors may interfere with exposure therapy by influencing threat appraisal and interfering with threat disconfirmation processing, understanding distress tolerance on safety behaviors could lead to enhancements of exposure-based anxiety disorder treatment.

This study hypothesized that: (1) Relative to no safety behavior controls, subjects who are randomized to use safety behaviors will display poorer distress tolerance as measured by persistence time (seconds) on a subsequent cold pressor challenge, (2) participants who are led to believe that the safety aid (liquid) will prevent circulation problems (threat-relevant rationale) will show increased distress tolerance (immersion time) in the first round but decreased distress tolerance in the second round of the cold pressor compared to participants who used the safety aid without a threat-relevant rationale, because appraisals of threat increase when the safety behavior is removed, (3) individuals with low baseline distress tolerance will be more sensitive to the threat-relevant rationale safety behavior manipulation than those with high baseline distress tolerance. Therefore, individuals with low distress tolerance at baseline and who are assigned to use safety behaviors with a threat-relevant rationale will have a larger decline in distress tolerance (i.e. immersion time) between the two challenges of the cold pressor, and (4) differences in threat appraisal between Challenge 1 (safety behaviors with threat-relevant rationale available) and Challenge 2 (no safety behaviors available) will mediate the effects on differences in distress tolerance (i.e. immersion time) and emotional reactivity (i.e. negative affect) between the challenges.

Methods

RECRUITMENT

Participants (N = 134) were recruited through the Psychology 301 subject pool, an introduction to psychology course at the University of Texas at Austin. Students who volunteered to participate in research completed a battery of online questionnaires. We then determined whether participants met inclusion criteria based on their responses (see Table 1). Individuals meeting the eligibility criteria were contacted via email and given the opportunity to participate in this study. Students interested in participating in the study were scheduled for an appointment at the Laboratory for the Study of Anxiety Disorders (LSAD). After completing the informed consent process, participants completed a battery of questionnaires (see Table 3) to measure specific psychopathological symptomatology and beliefs before starting their first cold pressor challenge.

Inclusion Criteria
1. Age 18 to 45 2. Speaks English fluently
Exclusion Criteria
1. History of any cardiac related disorder 2. History of Raynaud's disease 3. History of high blood pressure 4. History of heart disease 5. History of cardiac arrhythmias 6. History of fainting 7. History of seizures 8. History of frostbite

Table 1. Eligibility criteria.

RESEARCH DESIGN

At visit one, participants were randomized to one of three conditions for the first round of the cold pressor challenge: (1) safety behavior with threat-relevant rationale, (2) safety behavior without threat-relevant rationale, and (3) no safety behavior control (see Table 2). During visit two, participants in all three conditions completed a second cold pressor challenge without safety behaviors available. The visits were at least one day apart. Thus, the study was a 3 x 2 mixed model experimental design with condition as a three-level between-subjects factor and assessment period (Challenge 1 vs Challenge 2) as a two-level within-subjects factor. We measured participants' levels of distress tolerance at baseline and then stratified across three groups based on levels of physical and emotional distress tolerance (high or low). Group one allowed us to test the influence of threat appraisals on the relationship between safety behaviors and distress tolerance. Group two allowed us to test whether a safety behavior alone without threat appraisal had any influence on distress tolerance. Group three served as a no-manipulation control group. Assessments of physical distress (immersion time and heart rate variability), psychophysiological emotional responding, and threat appraisal response were conducted across four separate timepoints (before and after each of the two cold pressor challenges). The primary outcome was immersion time in seconds.

RANDOMIZATION

Participants were stratified based on the level of physical and emotional distress tolerance at baseline based on the Distress Tolerance Inventory (DTI), and randomized to one of the three experimental conditions (see above) using the web-based software Research Randomizer (www.randomizer.org).

Preparatory Procedures Common to All Experimental Groups. To prepare the cold pressor, research staff wet the powerhead suction cups and the side of the igloo, suctioned the powerhead to the side of igloo so that there was one centimeter of clearance between the bottom of the igloo and the powerhead intake, filled the igloo with cold water until it reached the bottom of the upper two suction cups, and dumped approximately 15 ice packs into the igloo to chill the water to between zero to two degrees Celsius. A tall thermometer was inserted so that the research staff could track the water temperature with a short refresh rate. A water head was inserted in the cold pressor to ensure the water was being circulated properly and constantly pushed water over the participants' hands to equalize the temperature of the water throughout the igloo. Research staff made sure the powerhead was unplugged before the participant arrived but plugged in once the challenge was about to commence.

COLD PRESSOR PROCEDURES

Table 2 presents an outline of the cold pressor procedures for each manipulation group.

Group	Baseline (Visit 1)	Cold Pressor Challenge 1 (max 5 minutes)	Post-Cold Pressor Challenge 1	Pre-Cold Pressor Challenge 2 (Visit 2)	Cold Pressor Challenge 2 (max 5 minutes)	Post-Cold Pressor Challenge 2
1	Assessments	Safety behavior with threat-relevant rationale	Assessments	Assessments	No safety behaviors available	Assessments
2	Assessments	Safety behavior without threat-relevant rationale	Assessments	Assessments	No safety behaviors available	Assessments
3	Assessments	No safety behavior control	Assessments	Assessments	No safety behaviors available	Assessments

Table 2. Cold pressor procedures for each experimental group.

Cold Pressor Challenge One Procedure for Group One – safety behavior with threat-relevant rationale. Subjects were instructed to pour 1 cup of liquid (dyed water) into the ice water at the start of the challenge. Participants were told that this liquid helped with blood circulation and subsequent pain. The following instructions were provided:

> *"You are about to begin the cold pressor challenge. During the challenge, I want you to continuously rate your current level of pain from 0- no pain at all, to 100- the most pain imaginable with the sliding scale on this iPad. Your goal is to keep your hand submerged in the tank, motionless, for as long as you can, until it feels too uncomfortable to continue. Stretch your fingers out across the bottom of*

the tank. We know that once you've been exposed to the cold water, there is a powerful constriction of the blood vessels and a reduction of blood flow to the distal tissue. As the temperature of the tissues fall, sympathetic nerve conduction is disturbed and vasoconstriction occurs. To counteract this process and help your blood circulation and subsequent pain, there is a cup of liquid in front of you that you will pour into the cold pressor. As you place your arm into the cold pressor, please pour this cup of liquid with your other hand into the ice water and mix it for 2 seconds (we will time you). Please keep your arm in the cold water as long as you can, but feel free to stop the task and remove your arm from the tank if at any point it becomes too uncomfortable. Once you remove your arm from the tank we will stop the timer. Do you have any questions?" (answer questions).

The participant was then instructed to place their dominant arm into the tank. Participants who reached the 5-min ceiling immersion time were asked to remove their hand.

Cold Pressor Challenge One Procedure for Group Two – safety behavior without threat-relevant rationale. Subjects were instructed to pour 1 cup of liquid (dyed water) into the ice water at the start of the challenge. The following instructions were provided:

"You are about to begin the cold pressor challenge. During the challenge, I want you to continuously rate your current level of pain from 0- no pain at all, to 100- the most pain imaginable with the sliding scale on this iPad. Your goal is to keep your hand submerged in the tank, motionless, for as long as you can, until it feels too uncomfortable to continue. Stretch your fingers out across the bottom of the tank. To help us visually see that the ice water is circulating properly throughout

the challenge, there is a cup of liquid in front of you that you will pour into the cold pressor. As you place your arm into the cold pressor, please pour this cup of liquid with your other hand into the ice water and mix it for 2 seconds (we will time you). Please keep your arm in the cold water as long as you can, but feel free to stop the task and remove your arm from the tank at any point if you become too uncomfortable. Once you remove your arm from the tank we will stop the timer. Do you have any questions?" (answer questions).

The participant was then instructed to place their dominant hand into the cold pressor. Participants who reached the 5-min ceiling immersion time were asked to remove their hand.

Cold Pressor Challenge One Procedure for Group Three – no safety behavior control. The third group for challenge one did not have access to safety behaviors (i.e. no access to liquid). The following instructions were provided:

"You are about to begin the cold pressor challenge. During the challenge, I want you to continuously rate your current level of pain from 0- no pain at all, to 100- the most pain imaginable with the sliding scale on this iPad. Your goal is to keep your hand submerged in the tank, motionless, for as long as you can, until it feels too uncomfortable to continue. Stretch your fingers out across the bottom of the tank. Please keep your arm in the cold water as long as you can, but feel free to stop the task and remove your arm from the tank if at any point it becomes too uncomfortable. Once you remove your arm from the tank we will stop the timer. Do you have any questions?" (answer questions).

The participant was then instructed to place their dominant hand into the cold pressor. Participants who reached the 5-min ceiling immersion time were asked to remove their hand.

Procedures Common to All Manipulation Groups Following Challenge One. Immediately following challenge one, all participants were administered the post-challenge Safety Behavior Query Form as an integrity check on potential safety behaviors utilized by the subject. Participants then completed the post-cold pressor challenge assessment battery and were reminded of their appointment to return to the laboratory for the second round of the cold pressor challenge on a separate day. Upon returning for their second visit, participants were instructed to complete a second pre-challenge assessment battery. Upon completing the pre-challenge measures, the following instructions were given:

> *"You are about to begin the second cold pressor challenge. During the challenge, I want you to continuously rate your current level of pain from 0- no pain at all, to 100- the most pain imaginable with the sliding scale on this iPad. Your goal is to keep your hand submerged in the tank, motionless, for as long as you can, until it feels too uncomfortable to continue. Stretch your fingers out across the bottom of the tank. Please keep your arm in the cold water as long as you can, but feel free to stop the task and remove your arm from the tank if at any point it becomes too uncomfortable. Once you remove your arm from the tank we will stop the timer. Do you have any questions?" (answer questions).*

The participant was then instructed to place their dominant hand into the cold pressor. Participants who reached the 5-min ceiling immersion time were asked to remove their hand. The preparatory procedures for the second cold pressor challenge were the same as the first challenge. Following the second administration of the cold pressor challenge, the participants completed the post-cold pressor challenge battery of assessments. Once these were completed, the participants were thanked for their participation in this study, debriefed, and allowed to leave.

MEASURES AND DATA COLLECTION

Assessments were administered at baseline, following the first round of the cold pressor challenge, before the second round of the cold pressor challenge, and finally, following the second cold-pressor challenge as outlined in the assessment schedule outline in Table 3. Only the demographics were administered once as a screening tool prior to baseline.

Demographics

Participants completed an online demographic assessment incorporating gender, age, ethnicity, year of schooling, history of any psychiatric disorders, and history of any cardiac or skin related disorder. Cardiac or skin-related disorder history were included in the demographics for exclusion criteria purposes, to ensure health and safety during the cold pressor challenge.

Assessment Measures

Anxiety Sensitivity Index-3 (ASI-3; Taylor et al., 2004). The subjective 18-item measure of anxiety sensitivity is rated on a 5-point Likert-style scale (0 = very little to 4 = very much). The ASI-3 shows strong construct, convergent, and discriminant validity (Taylor et al., 2004). The ASI-3 was used to assess participants' anxiety sensitivity.

Positive and Negative Affect Scale (PANAS; Watson, Clark, & Tellegen, 1988). The PANAS is a 5-point Likert-type scale (1 = very slightly or not at all, to 5 = extremely) and has shown strong discriminant and convergent validity, as well as internal consistency (Watson, Clark, & Tellegen, 1988). Participants' affect (both positive and negative) was assessed using the 20-item PANAS measure.

Distress Tolerance Scale (DTS; Simons & Gaher, 2005). The 15-item measure highlights an individual's ability to tolerate emotional distress, subjective appraisal of distress, negative emotions absorbing attention, and an individual's efforts to regulate the distress (Simons & Gaher, 2005). The DTS is rated on a 5-point Likert-type scale (1 = strongly agree to 5 = strongly disagree), where higher scores represent higher tolerance for distress. The alpha coefficient for the 14-item scale was .89, and also resulted in strong discriminant, convergent, and criterion validity (Simons & Gaher, 2005). The DTS was used to measure an individual's ability to tolerate negative distress.

Distress Tolerance Inventory (DTI; Telch, unpublished). The second assessment to measure an individual's ability to tolerate distress was the DTI. The DTI is a 10-item measure rated on a 6-point Likert-type scale (1 = strongly agree to 5 = strongly disagree), where higher scores represent higher tolerance for distress. This measure was included to assess physical distress tolerance in addition to emotional distress tolerance.

Discomfort Intolerance Scale (DIS; Schmidt, Richey, & Fitzpatrick, 2006). The DIS is a 7-item self-report measure rated on a 7-point Likert-type scale ranging from 0 (not at all like me) to 6 (extremely like me), where higher scores indicate higher intolerance for physical discomfort. The mean alpha coefficient for the DIS was 0.82, while also displaying adequate convergent and discriminant validity (Schmidt et al., 2006). This measure was included to assess participants' tolerance of physical discomfort, including pain.

Pain Catastrophizing Scale (PCS; Sullivan, 1995). The PCS is a 13-item measure rated on a 5-point Likert-type scale (0 = not at all to 4 = all the time), where higher scores represent higher fear of pain. Sullivan (1995) reported strong internal consistency with a Cronbach's α of .87. The PCS was included to assess an individual's fear of pain.

Heart Rate Variability (HRV). Heart rate variability was assessed using an Empatica watch– a device worn around the wrist. HRV was measured continuously beginning at five minutes prior to the start of the cold pressor challenge to determine a baseline heart rate, throughout both cold pressor challenges as a second measure of distress tolerance, and five minutes following the cold pressor challenge to ensure their heart rate normalized before leaving. This ensured the health and safety of the participants was monitored. If a participant's heart rate increased to over 90 percent of their maximum heart rate, the experiment was stopped.

Subjective Units of Destress Scale in Real Time (SUDS-RT; Wolpe, 1982; Telch, unpublished). SUDS is a Likert-type scale ranging from 0 (no anxiety) to 100 (extreme anxiety). However, the SUDS that was used in this study is a SUDS in real time (SUDS-RT). Instead of completing this scale in time increments, participants used a web-based adjustable sliding SUDS where they moved an index on a SUDS ruler throughout their participation during the entire duration of the cold pressor challenge. This allowed the participants to adjust their SUDS in real time rather than at certain timepoints, giving a more accurate measurement of their distress throughout the entirety of the challenges. The SUDS-RT was used to measure an individual's self-reported levels of emotional distress. Emotional distress ratings were sampled every second for the full duration of immersion. These data will be analyzed by exploratory growth curve analyses of the trajectory of the distress during the challenge and how the experimental manipulation affects this growth curve.

Appraisal and Coping Scale for the Cold Pressor Challenge (ACS-CP; Telch & Siegel, unpublished). The ACS-CP is an 11-item, self-report questionnaire in which participants rate their cognitions about and threat towards the cold pressor challenges (on a scale from 1 = strongly disagree, to 5 = strongly agree). An example of a question is: "I can handle the discomfort connected to the pain associated with my arm in cold water" This measure was used to see how safety behaviors impact participants' perceptions of their ability to withstand the cold pressor challenge. The ACS-CP was constructed for the purpose of this study, but built upon Bandura's (2006) recommendation to build self-efficacy scales, as well as Sherer et al.'s (1982) general self-efficacy scale.

Immersion Time (IT). A timer was initiated once the participant submerged their arm into the cold pressor and stopped when the participant removed their arm. Participants' behavioral approach score was assessed by their immersion time (in seconds) in the cold pressor. Immersion time was the primary outcome measure for assessing participants' level of distress tolerance during the cold pressor challenge.

Safety Behavior Query Form (SB-QF; Telch & Siegel, unpublished). Following each cold pressor challenge, participants completed a four-item author-constructed checklist about whether they used safety behaviors during the cold pressor challenge outside of our available manipulated safety behaviors (i.e., "tried to distract myself by focusing on other things"). This allowed us to ensure the safety behaviors used by participants were truly being controlled by our manipulation.

Visual Analogue Scale (VAS; Price et al., 1983). The VAS was presented as a 10-sectioned horizontal scale, anchored by verbal descriptors from "0 = no pain" to "10 = worst imaginable pain". The VAS was used to measure participants' retrospective rating levels of pain after the cold pressor challenges.

Manipulation Credibility Assessment (MCA; Telch & Siegel, unpublished). Participants assigned to the two safety behavior conditions were asked to complete a 2-item author-constructed scale (i.e., "How helpful was the liquid additive in managing your physical pain during the task?" and "How helpful was the liquid additive in managing your emotional distress during the task?"). Each of the above items were rated on a 5-point Likert scale ranging from 0 (not at all helpful) to 4 (very helpful). This measure was created to assess participants' beliefs about the safety aid manipulation.

Assessments	Baseline	Cold Pressor Challenge 1	Post-Challenge 1	Pre-Challenge 2	Cold Pressor Challenge 2	Post-Challenge 2
DEMO	X					
ASI-3	X					
PANAS	X			X		
DTS	X					
DTI	X					
DIS	X					
PCS	X					
HRV	X	X		X	X	
SUDS-RT		X			X	
ACS-CP	X			X		
IT		X			X	
SB-QF			X			X
VAS			X			X
MCA			X			

Table 3. Assessment schedule.

Note. DEMO = Demographics Questionnaire including history of any cardiac related disorder; ASI-3 = Anxiety Sensitivity Index 3; PANAS = Positive and Negative Affect Scale; DTS = Distress Tolerance Scale; DTI = Distress Tolerance Inventory; DIS = Discomfort Intolerance Scale; PCS = Panic Catastrophizing Scale; HRV = Heart Rate Variability; SUDS-RT = Subjective Units of Distress in Real Time; ACS-CP = Appraisal and Coping Scale for the Cold Pressor Challenge; IT= Immersion Time (seconds); SB-QF = Safety Behavior Query Form; VAS = Visual Analogue Scale for Pain; MCA = Manipulation Credibility Assessment.

ANALYSIS AND INTERPRETATION

Preliminary Analysis

To ensure equivalence in the spread of levels of distress tolerance in the three experimental groups for the first cold pressor challenge at baseline, we first conducted a one-way analysis of variance (ANOVA) on the different conditions.

Main Statistical Analysis

A two-way analysis of covariance (ANCOVA) was used to examine the combined and singular effects of manipulated safety behaviors on distress tolerance (i.e. immersion time). Specifically, our primary analyses consisted of a 3 x 2 repeated-measures ANCOVA, with the between-subjects factors of threat-relevant rationale safety behavior (yes or no or control), with the within-subjects factor of assessment time-points (two rounds of the cold pressor challenge), and with the covariate factor of participants' level of distress tolerance at baseline on the primary outcome measure (immersion time). Aim 1: the main effects of the 3 x 2 repeated-measures ANCOVA tested whether safety behaviors reduce an individual's distress tolerance (immersion time). Aim 2: an interaction of a 2 x 2 ANCOVA involving only the two groups who had access to safety behaviors tested whether the experimental manipulation of threat-relevant safety behaviors with threat-relevant or threat-irrelevant rationale affect distress tolerance (immersion time). Aim 3: an interaction of the covariate and the within-subjects factor of assessment time-points in an ANCOVA, involving only the group with threat-relevant rationale safety behaviors, tested whether the effect of the threat-relevant rationale safety behavior manipulation was moderated by participants' level of distress tolerance at baseline (DTI). Aim 4: a series of linear regressions were used to test whether threat appraisal and affect (PANAS) mediated the negative effects of safety behaviors on distress tolerance (immersion time).

Power Analysis

We conducted a power analysis for the repeated-measures ANCOVA proposed, and found that including 84 participants (28 per group) would allow for a power of 0.80 to detect a medium effect size (f=0.25). We recruited a total of 134 participants for this study in order to ensure that we were able to detect a medium effect size, if an effect was present.

Results

DEMOGRAPHICS

134 students volunteered to participate in research through an introduction to psychology course at the University of Texas at Austin participated in this research study. Figure 1 shows the flow of the patients through the study. The mean age for the sample was 19.3 (*SD*=1.4) years. Approximately 62% of the sample was female, 56% was white/Caucasian, and 76% of the sample was not Hispanic or Latino. Detailed demographic information about the sample can be found in Table 4.

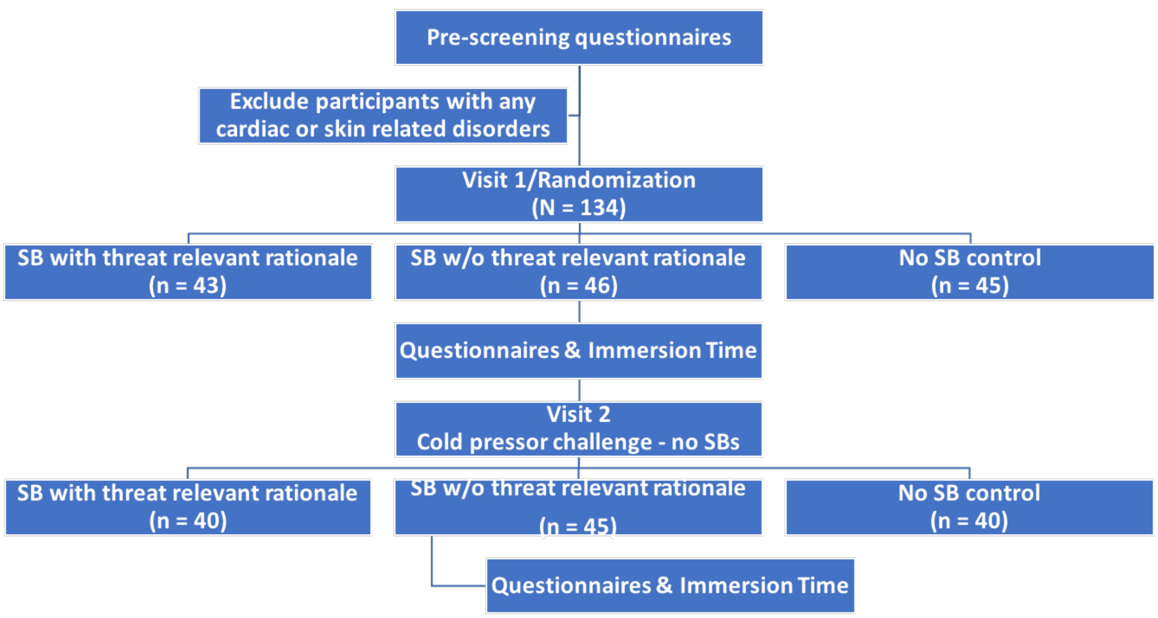

Figure 1. Consort Flow Diagram.

Note: SB = safety behaviors

Demographics	**N = 134**	**%**
Age	M = 19.3 (*SD*=1.38)	
Gender		
• Female	82	62.12%
• Male	50	37.88%
Race		
• White or Euro-American	78	55.71%
• Asian	44	31.43%
• Black or African American	10	7.14%
• Native American or Alaskan Native	3	2.14%
• Other	4	2.86%
• Native Hawaiian or Other Pacific Islander	1	0.71%
Ethnicity		
• Not Hispanic/Latino	102	76.12%
• Hispanic/Latino	32	23.88%
Year in College		
• 1st year	79	58.96%
• 2nd year	26	19.40%
• 3rd year	16	11.94%
• 4th year	12	08.96%
• 5th year	1	00.75%

Table 4. Demographics

MAIN STATISTICAL ANALYSES

A one-way ANOVA indicated that the spread of levels of distress tolerance in the three experimental groups for the first cold pressor challenge at baseline were not significantly different for both emotional [$F(2,131) = 0.40$, $p = 0.67$] and physical [$F(2,131) = 0.60$, $p = 0.55$] dispositional distress tolerance at baseline.

The main effects of the 3 x 2 repeated-measures ANCOVA indicated that safety behaviors did not significantly reduce an individual's distress tolerance (immersion time) between the two timepoints once the availability of safety behaviors are removed [$F(2,1) = 1.03$, $p = 0.40$] (Figure 2).

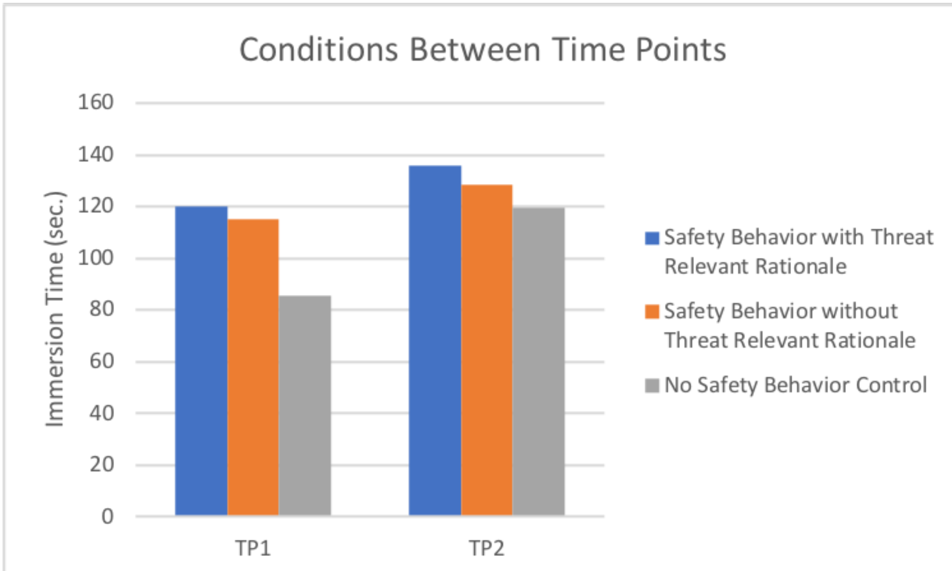

Figure 2. Immersion time between timepoints by condition.

The interaction of a 2 x 2 ANCOVA indicated that the experimental manipulation of threat-relevant safety behaviors with threat-relevant or threat-irrelevant rationale did not significantly mediate distress tolerance (immersion time) between the two timepoints [$F(1,119) = 1.19$, $p = 0.28$]. Relative to no safety behavior controls, subjects who were randomized to use safety behaviors only displayed poorer distress tolerance as measured by immersion time (seconds) on a subsequent cold pressor challenge between timepoint one and timepoint two but did not vary by condition [$F(1,1) = 200.01$, $p < 0.01$]. There was not a significant main effect of immersion time by safety behavior conditions versus control for both timepoint one [$F(1,132) = 2.98$, $p = 0.09$] and timepoint two [$F(1,119) = 0.34$, $p = 0.56$]. Moreover, there was also not a significant main effect of immersion time between safety behavior conditions for both timepoint one [$F(1,87) = 0.01$, $p = 0.91$] and timepoint two [$F(1,80) = 0.13$, $p = 0.72$].

The interaction of the covariate and the within-subjects factor of assessment time-points in an ANCOVA, involving only the group with threat-relevant rationale safety behaviors, indicated that there was no significant effect of the threat-relevant rationale safety behavior manipulation moderated by participants' level of dispositional distress tolerance at baseline (DTI) for both physical [$F(1,78) = 0.24$, $p = 0.63$] and emotional [$F(1,78) = 0.59$, $p = 0.45$] distress tolerance. Moreover, there was no significant moderation effect for emotional distress tolerance and immersion time by condition [$F(1,120) = 0.08$, $p = 0.78$] (Figure 3) or physical distress tolerance and immersion time by condition [$F(1,120) = 0.96$, $p = 0.33$] (Figure 4).

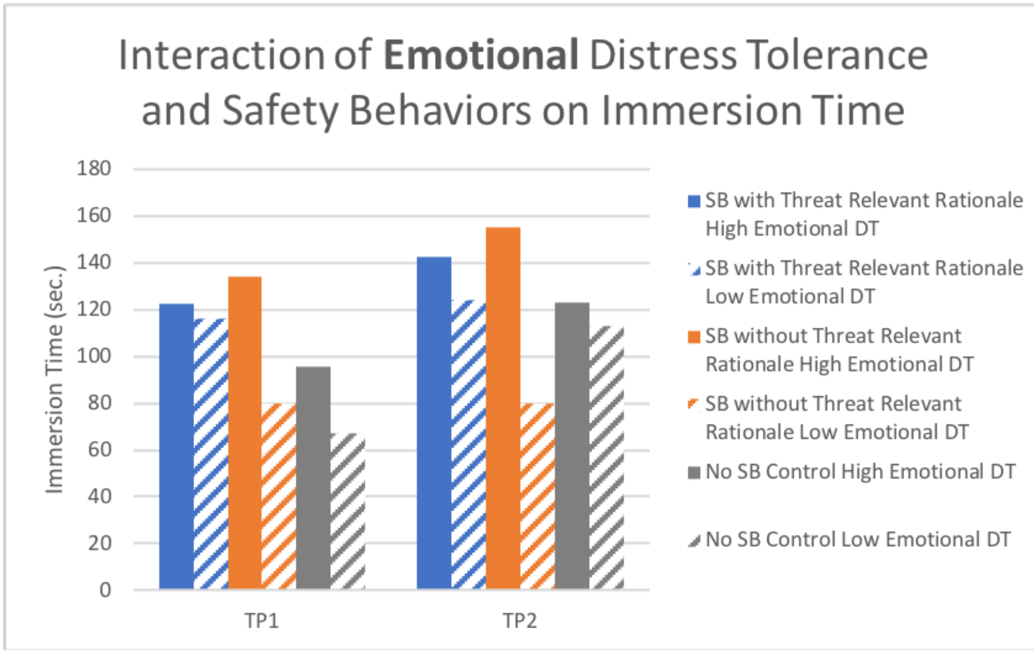

Figure 3. Emotional dispositional distress tolerance and immersion time by condition.

Note: TP1 = timepoint one; TP2 = timepoint two.

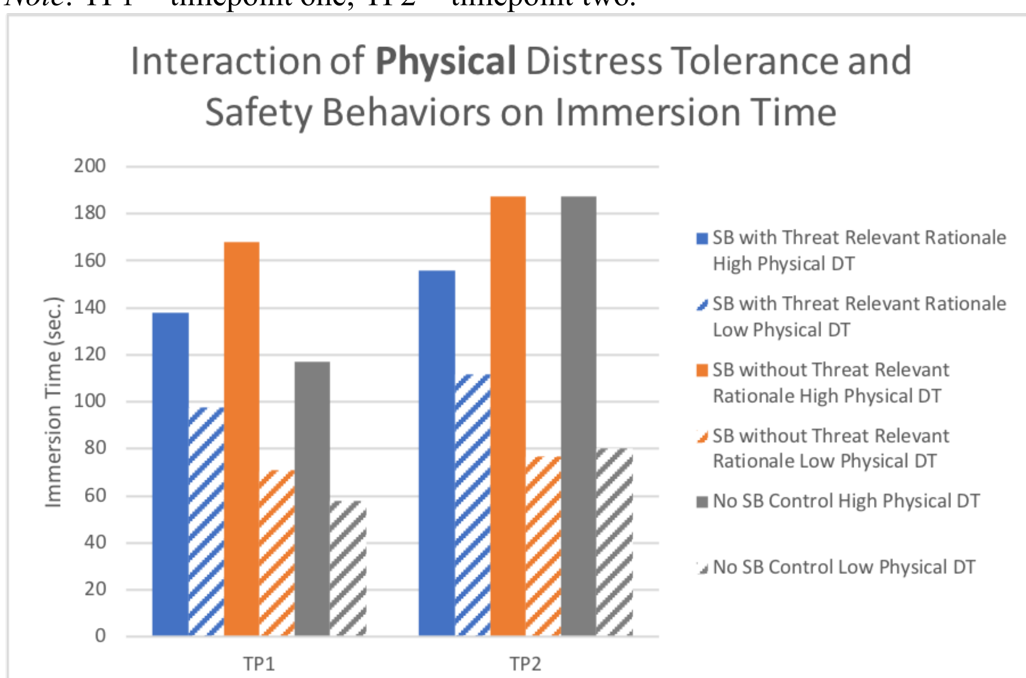

Figure 4. Physical dispositional distress tolerance and immersion time by condition

Confirming previous findings, there was a significant main effect of baseline dispositional physical distress tolerance for both timepoint one [$R^2 = 0.10$, $F(1,132) = 13.90$, $p < 0.001$) and timepoint two [$R^2 = 0.11$, $F(1,123) = 15.64$, $p < 0.001$], but this did not remain significant for emotional distress tolerance for both timepoint one [$R^2 = 0.02$, $F(1,132) = 2.85$, $p = 0.09$) and timepoint two [$R^2 = 0.02$, $F(1,123) = 2.17$, $p = 0.14$] (Figure 5)**.** Specifically, participants who had high dispositional physical distress tolerance had longer immersion times than those with low physical dispositional distress tolerance, at both timepoints.

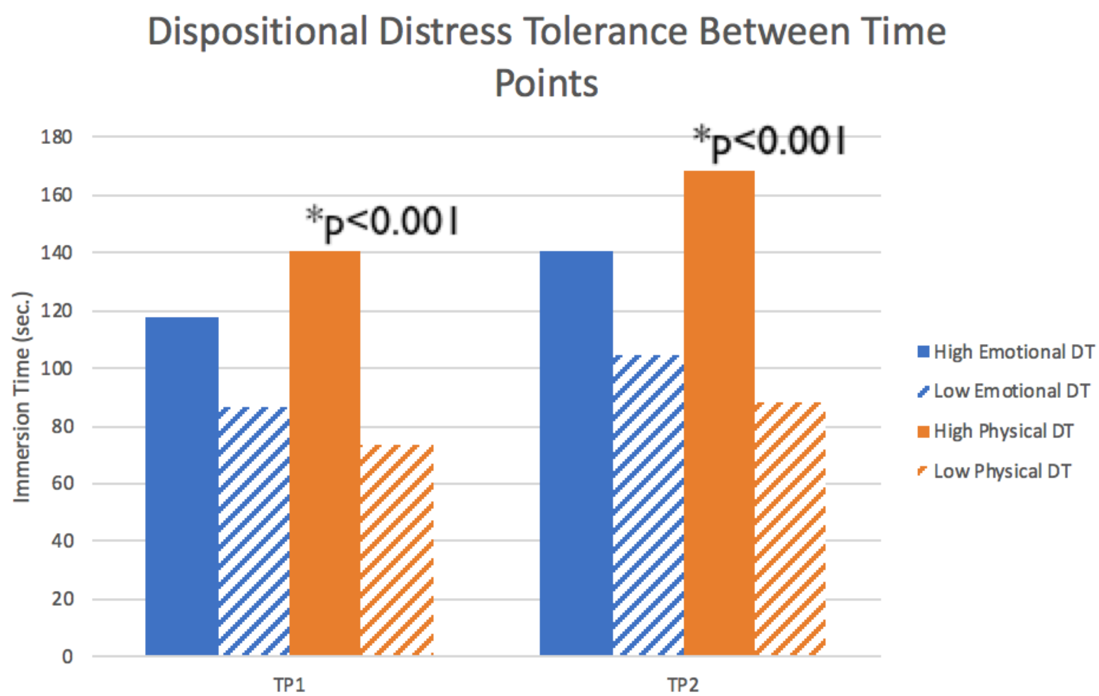

Figure 5. Dispositional distress tolerance between timepoints

A series of linear regression analyses revealed that threat appraisal and affect did not mediate the negative effects of safety behaviors on distress tolerance (immersion time) within timepoint one for both negative [$R^2 = 0.03$, $F(2,47) = 1.86$, $p = 0.17$] and positive affect [$R^2 = 0.03$, $F(2,47) = 1.86$, $p = 0.17$], and within timepoint two for both negative [$R^2 = 0.10$, $F(2,47) = 3.81$, p 0.94] and positive affect [$R^2 = 0.19$, $F(2,47) = 6.67$, $p < 0.05$] since the coefficients increased for positive affect. Moreover, threat appraisal and affect did not mediate the negative effects of safety behaviors on distress tolerance (immersion time) across timepoints for both negative [$R^2 = -0.00$, $F(3,46) = 0.98$, $p = 0.41$] and positive affect [$R^2 = -0.02$, $F(3,46) = 0.69$, $p = 0.56$].

Discussion

CONCLUSIONS

The purpose of this study was to test the effects of distress tolerance on safety behaviors through experimental manipulation of safety behaviors and the rationale of their use. More specifically, through this experimental manipulation, we examined whether threat appraisals mediate the negative effects of safety behaviors on distress tolerance. Inconsistent with our hypotheses, participants' threat appraisals did not significantly mediate the negative effects of safety behaviors on distress tolerance. Moreover, this mediation was not moderated by individuals' levels of physical or emotional distress tolerance at baseline.

Confirming previous findings, this study's findings suggest that people with low physical dispositional distress tolerance are doing worse overall when in distressing states. If individuals have low physical dispositional distress tolerance, this may override the value of safety behaviors for physical distress tolerance. However, these significant findings did not hold true with individuals' levels of emotional dispositional distress tolerance at baseline.

Previous studies have found that both dispositional distress tolerance and the use of safety behaviors may interfere with exposure therapy by influencing threat appraisal and interfering with threat disconfirmation processing. However, this study's findings suggest that the influence of safety behaviors on dispositional distress tolerance may not impact the effectiveness of anxiety disorder treatment.

LIMITATIONS

Several limitations to our study should be noted. A sample of undergraduate participants was recruited for this randomized experimental study. Conducting this study on this demographic is both efficient and cost-effective. However, our results may not be generalizable to a treatment-seeking population. A second limitation of this study is the ecological validity of the distress tolerance measure. The measurement of immersion time in a cold pressor challenge is not easily disseminated to real-life settings. Third, we only manipulated specific types of safety behaviors and therefore may not be accounting for other safety behaviors that could be used during the cold pressor challenge, outside of our Safety Behavior Query Form.

FUTURE DIRECTIONS

Future studies should examine whether the results would be replicable in a clinical population or whether a different distressing challenge would produce different results. Based on the results of our study, we recommend that therapists do not limit therapy options based on an individual's ability to tolerate negative emotional and physical distress.

SUMMARY

In summary, this is the first study to investigate the effects of distress tolerance on safety behaviors through experimental manipulation of safety behaviors and the rationale of their use. Findings suggest that the influence of safety behaviors on dispositional distress tolerance may not impede the effectiveness of anxiety disorder treatment.

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